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February 23-26, 2016
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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

The National Marine Mammal Peer Review Committee (NMMPRC) holds at least one annual face-to-face meeting to conduct scientific peer-review of marine mammal issues. This approach provides the opportunity to bring together experts on marine mammals from Fisheries and Oceans Canada (DFO) with specific contributions from non-DFO experts to ensure high quality review of the scientific results and to provide sound scientific advice as the basis for the management and conservation of marine mammals in Canada. When time permits, this annual meeting is also an opportunity to review ongoing research projects and provide feedback or guidance to the scientists involved. In addition to these Proceedings, several Research Documents and Science Advisory Reports will be published as a result of the meeting.

This meeting, the second in the 2015/16 fiscal year, was held at the Sheraton Wall Centre from February 23-26, 2016. The participants invited to this meeting included individuals from DFO (Ecosystems and Oceans Science, Ecosystems and Fisheries Management, Species at Risk), NOAA, Cascadia Research, Vancouver Aquarium, Oceans Initiative, Mingan Island Cetacean Study, academia and other invited experts.

RÉSUMÉ

Chaque année, le Comité national d'examen par les pairs sur les mammifères marins (CNEPMM) organise au moins une réunion en personne où l'on procède à un examen scientifique entre pairs de questions touchant les mammifères marins. Cette approche, qui réunit des experts en mammifères marins de Pêches et Océans Canada (MPO) et des experts externes au MPO, permet d'effectuer un examen de qualité élevée des résultats scientifiques et de formuler des avis scientifiques fiables qui serviront de fondement à la gestion et à la conservation des mammifères marins au Canada. Lorsque le temps le permet, les participants à cette réunion en profitent également pour se pencher sur les projets de recherche en cours et formuler des commentaires ou des conseils à l'intention des scientifiques qui y prennent part. En plus de ce compte rendu, plusieurs documents de recherche et avis scientifiques seront publiés à la suite de la réunion.

Cette réunion, la deuxième de l'exercice 2015-2016, s'est tenue au Sheraton Wall Centre du 23 au 26 février 2016. Parmi les participants invités à cette réunion, on comptait des personnes de Pêches et Océans Canada (Sciences des écosystèmes et des océans, Gestion des écosystèmes et des pêches, Espèces en péril), de la National Oceanic and Atmospheric Administration (NOAA), de Cascadia Research, de l'Aquarium de Vancouver, de l'Oceans Initiative, de la Station de recherche des îles Mingan, des universitaires et d'autres experts invités.

WORKING PAPER 1A: DISTRIBUTION, MOVEMENTS AND HABITAT FIDELITY PATTERNS OF FIN WHALES (*BALAENOPTERA PHYSALUS*) IN CANADIAN PACIFIC WATERS

Authors: L.M. Nichol, R.M. Abernethy, B.M. Wright, S. Heaslip, L.D. Spaven, J.R. Towers, J.F. Pilkington, E.H. Stredulinsky, J.K.B. Ford

Rapporteur: Shelley Lang

Discussion:

Section 1: Use of sighting data from ship based surveys for modelling of fin whale distribution and density

The committee requested clarification on why the number of surveys used for the analysis of the distribution and density of fin whales in the Hecate Strait-Queen Charlotte Sound region were less than the total number of on-effort surveys conducted. The authors indicated that they felt there was too much heterogeneity in effort among surveys and, therefore, the number of surveys was restricted to those with similar levels of effort.

Concerns were raised by the committee regarding what impact the exclusion of some surveys may have had on the modelling of distributions and densities and, in particular, whether range of depth as a model factor may be less important if all data were included. It was suggested that the accuracy and precision of estimates may be improved if all surveys were included in the modelling. The committee also expressed concern regarding what confidence there is in the predictions for the distribution and density of fin whales in the southern extent of the modelled area given that there appears to be a lack of survey effort in this area.

A participant indicated that results from recently published work, using density surface modelling, showed patterns consistent with those presented. The committee requested that references to those published results be included in the discussion section of the paper.

The committee requested that descriptions and graphics for all of the surveys conducted in the Hecate Strait-Queen Charlotte Sound be included as an appendix with clear indication of which surveys were used for the analysis to give a sense of what impact the exclusion of some surveys may have had on the results.

The committee asked for clarification on how the inshore and offshore regions are delineated. In particular, why the division between regions occurs at the 200m isobath off of Vancouver Island but at the 1000m isobath north of Vancouver Island. The committee also asked what the purpose of the five subdivisions within the inshore region was, given that they were not treated separately for the purpose of the distribution and density modelling. The authors indicated that these delineations are those used for photo identification survey work. The committee requested that the purpose of the division of inshore and offshore regions and the areas within the inshore be made more explicit in the text of document.

The committee asked why XY co-ordinates were used in the modelling and why Y (latitude) was retained preferentially. The authors indicated that the use of XY coordinates was consistent with previously published work for similar modelling studies and that Y was retained here as a proxy for unknown oceanographic characteristics related to the north-south orientation of Moresby Trough which may be influential. It was suggested that the authors consider using a two dimensional smoother instead of only X or Y. The committee requested that the explanation of why the XY co-ordinates were included in the modelling and why only Y was retained be added to the document. It was noted that which of X and Y is latitude and which is longitude is not specified in the document.

Section 2 – use of photo identification to examine fin whale movement and abundance

The committee noted that there are additional published data that support the abundance estimates given in this study and that those data should be brought into the discussion of the document so that the totality of support for these values is documented. The committee requested that the super-population estimate from the mark-recapture analysis be included and its concurrence with estimates from other published work be emphasized.

The committee pointed out that the use of apparent survival is incorrect in this case and the wording should be changed to reflect the fact that the values are not referring to survival per se but rather residence within the area/population over time.

The committee noted that Table 9 does not appear to sum correctly, but that this may be due to misunderstanding of what the Table is attempting to demonstrate. It was requested that the explanation be improved to better reflect intent and that the numbers be checked to verify that they are correct.

The committee noted that Figure 12 may be misleading since it makes it appear as though there has been a dramatic increase in population. Since 2014 estimate is the end product of the analysis and the only estimate with any credence, it was requested that the figure be removed.

Section 3 – analysis of movement and dive behaviour using satellite tags

The committee noted that the authors' identification of the inability of the state-space model (SSM) to classify 12% of movement as either area restricted search (ARS) or travel as a problem is an overstatement since you would expect that some fraction of the tracks could not be classified into one of the two states. It was requested that the text be changed to reflect this.

The committee noted that the presence of ARS should not be interpreted solely as "foraging". ARS categorized behaviours could be consistent with several other behavioural modes including social aggregation. The committee requested that the potential for ARS to refer to a number of different behaviours be made clearer in the document and that ARS areas not be considered as simply indications of potential foraging. The committee suggested that future work could consider whether it is possible to combine habitat data with the SSM results and dive behaviour to examine what animals may be doing in areas where ARS is concentrated.

The committee noted that it is not clear what the "snow" around the tracks in Figure 13 represents and that this should be clarified. The committee also requested that the total tracks for all individuals be included as an appendix in the document since this would provide a better context for the area analysed and make it clearer that tagging was focused in a small area which may bias some conclusions regarding areas of ARS within the larger study region. It was also requested that 1) an inset of the overall study region be provided for Figures 13 and 14 to provide context for where these animals were tagged within the greater area of the BC coast and 2) bathymetry be included in all maps of satellite tracks.

The committee suggested that the Figure 16 dive depth data be presented as box and whisker plots instead of the raw data since the present configuration makes it unclear that there are data from only a limited number of animals. The committee also raised the question about whether there may be a bimodal distribution of dives during the day based on the figure presented (Figure 16) and suggested that it be investigated.

The committee chair requested that details of results be added to the abstract.

WORKING PAPER 1B: PATTERNS OF FIN WHALE (*BALAENOPTERA PHYSALUS*) SEASONALITY AND RELATIVE DISTRIBUTION IN CANADIAN PACIFIC WATERS INFERRED FROM PASSIVE ACOUSTIC MONITORING

Authors: JAMES F. PILKINGTON, EVA H. STREDULINSKY, ROBIN M. ABERNETHY, JOHN K.B. FORD

Rapporteur: Shelley Lang

Discussion: The committee asked whether the deployment locations for the recording devices were related to expected distributions of the fin whales or some other factor. The authors indicated that the deployment locations were influenced by a number of practical considerations including the footprint of the trawl fisheries in the region, the strength of currents and the logistics of placing moorings. The committee requested that details on how the deployment locations were selected be added to the document.

The committee asked for details on the type of mooring used for the receivers since this can influence the receiver's detection capabilities. The authors indicated that these were moored using acoustic releases and that there is some potential for that to have influenced actual receiver ability due to placement on uneven bottom substrate. The authors suggested that it would be valuable in the future to play tones around arrays to confirm their orientation and receiver capability at the time of deployment. The authors also noted that the modelling of transmission loss predictions is a coarse correction factor at this point but that future deployments could incorporate methods for field validation of transmission loss.

The committee noted that the current prediction map of transmission loss for the Triangle Island receiver suggests that vocalizations by whales near the southern canyons of Hecate Strait would not have been detected. The authors indicated that the canyons were within detection range of the Triangle Island receiver and that the transmission loss prediction models indicate that any whales vocalizing in the area of the southern canyons should have been detected by the receiver at Triangle Island. The committee requested that the transmission loss area diagrams for the eight receivers be overlaid on the map of the study region to make the range of the individual receivers and the areas of overlap between receivers clearer.

The committee asked for more information on validation of the Fin Whale Call Index (FWCI). The authors indicated that there was no quantitative validation of the call index but that manual checks were conducted randomly to examine whether the call index was representative. The committee requested that a description of the qualitative validation of the FWCI be included in the document.

The committee asked for clarification on how the application of the area-transmission-loss correction factor may affect the data. The committee expressed concern that it was not clear how much of the variation in the average daily call index (Figure 3) is true variation and how much is due to correction since it appears from the transmission loss plots that there is some correlation between the effectiveness of the receiver and the level of the average daily call index. The authors indicated that the correction factor was meant to standardize the call index to the same scale across sites so that a relative comparison could be made. The committee suggested that it would be valuable to show a plot of the uncorrected values for comparison and that the application of the correction and its effect on the values needs more explanation in the document. The committee also noted that it was unclear why in some areas the average daily call index went below zero. The authors noted that the levels below zero occurred when, on average, the call levels were lower than ambient noise levels.

The committee noted that there is a mismatch between the survey period used for modelling fin whale distribution presented in Working Paper 1A and the period of detections observed in this

study. From the acoustic data it appears that the periods in July and August, when visual surveys are conducted, are low in the level of vocalizations for the same area. This suggests that visual surveys may not be covering areas of importance for other times of the year. The authors indicated that there is a need to look at other areas but that the mismatch between visual surveys and timing of calls could relate to changes in behaviour. Differences in call index are not necessarily related to abundance they may simply reflect less overall calling by the same number of individuals. The committee asked whether there is any evidence that there are areas which are predominantly male. The authors indicated that it is unknown but that historical whaling data suggests that there is separation between the distribution of males versus females.

The committee asked if there is any indication that there is geographic variation in the ratio of A to B calls that may indicate some type of population structure. The authors indicated that geographic variation in the inter-pulse interval with differences between the inshore and offshore have been noted. However, nothing is known about whether variation in the inter-pulse interval persists over time and thus it is unclear whether the patterns could be used as reliable indicators of population structure. The authors indicated that there is a need to do more work to identify geographic differences in song structure. The committee suggested that a short description of the potential differences in song type and the need for further work on this in relation to identifying population structure be added to the discussion.

A participant indicated that there is additional acoustic detection data from receivers deployed in the region by his group that could be made available for analysis. The committee suggested that it may be valuable to add a brief summary comment on any results from these additional detection data to the discussion of the document even just as a personal comment.

Minor note: Transmission figures – distances are shown in metres – change to km.

WORKING PAPER 1C: INFORMATION IN SUPPORT OF THE IDENTIFICATION OF CRITICAL HABITAT FOR FIN WHALES (*BALAENOPTERA PHYSALUS*) IN CANADIAN PACIFIC WATERS

Authors: L.M. NICHOL AND J.K.B. FORD

Rapporteur: Nell den Heyer

Discussion: This working paper provided a synthesis of the Working Papers 1A and 1B and previously published work to identify biologically important habitat of Fin whales. As such the authors intend to use the maps and figures presented in those papers, once the final revisions have been addressed. It was also suggested that efforts be made to reduce repetition with the other working papers.

There was considerable discussion about the 'inshore' and 'offshore' distribution of fin whales and the available data. It was suggested that the rationale to recommend critical habitat for the 'inshore' and not the 'offshore' be made more clear.

Sources of information

The committee suggested that additional information that was not presented in the other working papers would be valuable to defining critical habitat:

- Calving data that was excluded from the mark-recapture analysis should be summarized, perhaps in a table of when and where calves seen. This would provide insight into the use of habitat.
- There are published estimates of abundance and fin whale distribution based on systematic coverage from 3 seasons over 5 years that should be cited (Williams and Thomas 2007,

Best et al. 2015), as they provide support for the population estimate for the 'inshore' fin whales and the importance of Moresby Sound.

- More details on the whaling data that were the primary source of information in the previous 2011 critical habitat review should be included. Unfortunately these data do not have measures of effort and the life functions associated with the whaling locations are unknown, but they do provide insight into the historical distribution, particularly for the offshore.
- Gregr and Trites (2001) showed a habitat map (Fig 8) that does include Moresby Trough and otherwise is offshore.
- Genetic data are not available.

It was noted that the definition of critical habitat includes historically important habitat, which could be important for recovered populations, and that this should be discussed in the paper.

There was considerable discussion regarding the use of the spatial GAM (Generalized Additive Model) to define biologically important habitat and the acoustic and pop-up satellite datasets that were used to better understand how animals use the identified habitat. There were questions about what habitat maps might look like if more dynamic variables and biological features (e.g. chlorophyll a) were included in the habitat model.

It was the consensus of the committee that there was enough information to define critical habitat for inshore areas.

Table 3

Table 3 was carefully reviewed and a number of clarifications and small changes were suggested:

- remove air quality from the table, as air quality data were not discussed or presented
- remove "optimal" from prey attributes; does not have to be optimal, only needs to be sufficient to support
- invert features and attributes for prey (feature) and krill (attribute)

There was discussion regarding evidence that fin whales use acoustics for foraging and the committee suggested that the paper provide a more complete evaluation of the evidence for the use of acoustics in foraging. It was noted that the statement 'and interferes with life process such as communication and foraging' may require more research.

There was also some discussion regarding the information on prey species. There are several lines of evidence to suggest that fin whales are primarily feeding on krill. The whaling data suggested that fish (saury and herring) are only a minor fraction of the diet, but the whaling data was primarily offshore. There is very little data on inshore diets, where there are more small pelagic species. There are associations of forage fish where fin whales are feeding, and it was suggested that using hydroacoustics for prey fields may be useful in future research.

Discussions also explored what we know about how noise impacts communication of fin whales. Some comment can be made with respect to the noise levels at the frequencies of the vocalizations, but it was noted that there is no audiogram for these whales.

It was asked why there are no comments about migration routes? The authors replied that there is no strong migration pattern apparent.

Important habitat bounding box

Discussions focused on the important habitat near the southern boundary and the rationale for not recommending important habitat in Dixon Sound.

It was noted that Dixon Sound was not contiguous with Hecate Strait because of a shallow area in the north which forms a natural boundary. It was also noted that there were few matches in the sightings of individual whales between Dixon Entrance and Hecate Strait, so the fin whales are not from the same 'inshore' group. Further there is a lack of information on fin whales use of this area as there are no satellite or acoustic data. Again, the committee recommended that the focus of this analysis on inshore population be better explained.

There was careful review of the southern boundary of the important habitat, including extensions southward to SW Vancouver Island, reduction northward to the isobath around Moresby Trough and a few options in between. It is well established that Moresby Trough is an area of high abundance. The habitat model identified the other submarine areas (other canyons) and the coast line (the island just south of Caamano) as preferred habitat. And, there are observations of large aggregations in these areas that were not used in fitting the model. In addition to the habitat model, satellite tags indicate the whales are using the whole area, while the historical whaling data also suggests extension to the south. Further, work by R. Williams suggests Moresby trough down to Queen Charlotte Sound is important, as these offshore canyons are very productive.

It was recognized that some of the data presented supported extending the bounding box southward to SW Vancouver. Again, the discussion returned to the analysis presented being used to identify important habitat in the inshore, with offshore fin whale habitat to be addressed at a later date, when the sightings data and other information are more fully analysed and reviewed.

Table 4

A subgroup of participants agreed to work with authors to make the pathway presented clearer.

WORKING PAPER 2: INFORMATION IN SUPPORT OF THE IDENTIFICATION OF ADDITIONAL CRITICAL HABITAT FOR RESIDENT KILLER WHALES (*ORCINUS ORCA*) OFF THE WEST COAST OF CANADA

Authors: JOHN K.B. FORD, JAMES F. PILKINGTON, AMALIS REIRA, MAYUKO OTSUKI, BRIAN GISBORNE, ROBIN M. ABERNETHY, EVA H. STREDULINSKY, JARED R. TOWERS, AND GRAEME M. ELLIS

Rapporteur: Nell den Heyer

Discussion: This working paper summarized the available data for the identification of two important habitats for Killer Whales off the BC coast. The Killer Whale population and social structure of the northern and southern Killer Whales is known in detail and helps to identify the important habitat.

There was considerable discussion regarding the nature of the encounter data from the vessel-based field studies. It was noted that the encounters with pods of Killer Whales are not well conveyed by a single point. Some of the pods are large and extend over wide areas and some of the encounters occur over extended periods of time and move across large areas. It was also noted that the GPS locations associated with the first encounter would be clustered around the vessel launches. These clarifications are relevant to Figure 5, as there have been more observation of whales in the proposed important area (Figure 31) than represented by a plot of

the first encounters. It was suggested that the number of sightings inside the proposed important areas be reported and the methodology be explained in the text, and if possible the maps of encounters be modified to convey more information about the encounters.

There was also discussion about how the sightings data informed the identification of important habitat. Two inshore areas (Tofino Bay and Barkley Sound) that had a high number of sightings owing primarily to a high sighting effort, were not identified as important habitat. Also, for Barkley Sound, there was a period when there were large hatchery-Chinook returns that supported Killer Whales, but in recent years whales are not using the habitat. It would be helpful to include sightings data standardized by effort to get better sense of distribution.

Discussions explored the ways to make full use of the large amount of data available on these whales. There was some discussion of how more quantitative descriptions of how the animals use the important habitats could be developed and if this would be of benefit to assessing important habitat for other Killer Whale populations (or other cetaceans). It was also noted that the tremendous amount of data on this population could support spatial modelling, but it was not necessary to identify these biologically important areas.

The potential to bias the identification of important areas by having more data in some places than other was discussed. With respect to placement of hydrophones, it was noted that not everywhere a hydrophone has been deployed has supported the identification of important habitat.

Several times, discussions returned to the importance of Chinook fishing areas as a defining feature of important habitat for Killer Whales. One participant wondered if there were any Chinook fishing areas that don't have Killer Whales. It was agreed that work on the distribution of Chinook and Chinook fisheries would be helpful to understanding important habitat for Killer Whales.

Also, it was suggested that acoustic data could be used to get information about activity and the use of habitat.

Southwestern Vancouver Island Bounding Box

There was a review of all the data and rationale for the boundaries and how the data are used to establish the bounding box. The boundaries for Southwestern Vancouver Island important habitat in the paper are not well supported with the data as it is presented. The presentation of only the first encounter location for sightings and predation events undermines the argument, as it appears that the Killer Whales are not abundant inside the bounding box. It was also noted that additional text explaining habitat use and the reason for extending the boundary to the 200m isobath is needed. Similarly the additional information about productive Chinook areas need to be made clear, and if available, maps for the Chinook fishing areas would be helpful to include. In defence of a larger bounding box that includes known Chinook fishing areas, it was noted that a recovered population would need more Chinook than the current population.

Modification to better explain the encounter and predation data, as well as how the various data sources were used to define the boundaries will be added to the document and circulated before the Science Advisory Report is presented.

Western Dixon Entrance bounding box

The boundaries for the Western Dixon Entrance important habitat area are more clearly defined and the data associated with the bounding box were presented. The western boundary was defined by fish abundance, acoustic monitoring, and sightings. Discussion focused on the eastward extent of the box, along the migratory route of both salmon and Killer Whales, and

observations of foraging events. The northern boundary was also discussed and it was suggested that the 200m isobath is defensible and perhaps easier for implementation.

Again, it was noted that a map of the Chinook fishery would be helpful.

Given the rationale for the Dixon Entrance habitat, it was suggested that other areas might be considered as well, in particular Chatham sound. The authors explained that at present there are not a lot of data from Hecate Strait because of conditions working in that area, and the acoustic data from this area are now being analysed, but at present there was not enough evidence to suggest that this was an important habitat.

Table 1. Functions, features and attributes

The tables presented were based on the already legally defined Critical Habitat for Killer Whales. Activities specific to the newly identified important areas will also need to be captured, and other notable differences need to be modified; for example the rubbing activity does not occur in the newly identified important habitat.

It was noted that the acoustics were identified twice, once in water column and later independently.

There was some discussion about how to define the attributes and if the prey for Chinook would be useful to identify. Ultimately, the committee decided to stay focused on the Killer Whale habitat, and not describe the larger ecosystem.

The second table on pathways was to be reworked by a subgroup and presented in the Science Advisory Report later in the meeting.

The authors later presented changes to the paper that addressed the comments above and highlighted the importance of Sablefish predation events as being an interesting and potentially important observation in the newly defined important area. Again, the importance of Chinook to Killer Whales was emphasized and maps of historic Chinook fishing grounds were presented.

Discussion of the tracking data emphasized, for example, that a track of J27 was actually a track of the J pod of 26 animals, so these data represents a significant portion of the population and are useful as an illustration of habitat use.

WORKING PAPER 3B: BLUE WHALE CONTINUOUS FREQUENTATIONS OF ST. LAWRENCE HABITATS FROM MULTI-YEAR PASSIVE ACOUSTIC MONITORING SERIES

Authors: YVAN SIMARD, NATHALIE ROY, FLORIAN AULANIER, AND SAMUEL GIARD

Rapporteur: Robin Abernathy

Discussion: The committee requested clarification regarding Figure 2 and what the black and red colors, and different line thicknesses, symbolized.

It was noted that ice coverage in the study area could be affecting results, and the committee suggested adding detection area maps in the paper.

While discussing the results at Belle Isle which indicate no blue whale calls, it was noted that although the historical whaling data showed the area was important, there are only a few observations of whales in this area in recent years. Blue whales may be on the Plateau and thus not being picked up by the Belle Isle station.

It was noted that seasonality in the figures is difficult to interpret – the authors will clarify. The committee noted that it would be useful to have detailed station-specific figures, at least for the

more active stations, that compare (vertically stack) each year of the data to ease in the interpretation of seasonality.

It was suggested that because detection area was presented for A calls, that the paper should include the same for the D calls.

It was noted that if it is important to keep in mind the detection range in interpreting the results, then it needs to be made clearer to the reader how to interpret the detection range.

It was noted that in Table 2, the objective of the table should be clarified.

The committee requested that spectrograms of A and D calls be included.

A participant noted that ice is noisy, and was concerned that the detection distances would be much smaller with ice present. It was requested that the authors add relevant literature that takes this into account. The authors stated that ice noise is not present in the noise band, and they will address this issue in the paper.

There was some discussion regarding whether any physical change in propagation due to ice cover exists, and that the authors should mention ice coverage and its implications in the Discussion.

WORKING PAPER 3C: THE DISTRIBUTION AND FORAGING BEHAVIOUR OF BLUE WHALES (*BALAENOPTERA MUSCULUS*) AND OTHER CETACEANS IN RELATION TO THE BEHAVIOURAL DYNAMICS OF KRILL (*THYSANOESSA SP* AND *MEGANYCTIPHANES NORVEGICA*) IN THE ESTUARY AND NORTHWESTERN GULF OF ST. LAWRENCE

Authors: MCQUINN, I.H., GOSSELIN, J.-F., BOURASSA, M.-N., MOSNIER, A., ST-PIERRE, J.-F., PLOURDE, S., LESAGE, V., RAYMOND, A.

Rapporteur: Brianna Wright

Discussion: The committee requested a clearer link between the Latin and common names of the two krill species in the Introduction.

A participant asked why 80m was the limit chosen to define shallow krill patches? The authors replied that this is based on plankton; by choosing a deeper threshold (e.g., 100m), they were concerned this might also include the top of the daytime depth distribution of krill (and they didn't want to include these as part of surface swarms). The committee requested that the authors address the discrepancy between the 80 and 100m thresholds as the definition of surface krill patches in the paper.

The committee requested that a figure showing the distribution/density of shallow patches of krill on the map of St. Lawrence estuary be included in the paper.

WORKING PAPER 3D: WINTERING AREAS, FALL MOVEMENTS AND FORAGING SITES OF BLUE WHALES SATELLITE-TRACKED IN THE NORTHWEST ATLANTIC

Authors: VÉRONIQUE LESAGE, KATHERINE GAVRILCHUK, RUSSEL D. ANDREWS, RICHARD SEARS

Rapporteur: Brianna Wright

Discussion: There was some discussion regarding how the polygons were defined in Figure 6, e.g. was the choice of 5 consecutive ARS (area-restricted search) points arbitrary? The authors

explained that they used 5 consecutive ARS positions to define the polygons, as this is recommended in the literature because you're using 95% MCPs (Minimum Convex Polygons).

The authors also explained they didn't want to remove positions in the Anticosti Gyre estimated as ARS (95% MCPs chosen to exclude outliers). They could use fewer points (e.g. 50% MCP). It was noted that ARS points around a curve will lead to the MCP including middle portions that may not be important for foraging (food is around the edges of the gyre while it is absent in the middle'). The authors will add a point in the discussion to reflect this.

It was asked if the authors accounted for distances between these 5 points for MCP. The scales are quite different between polygons; could turns on a smaller spatial scale be identified by changing the threshold in some way, for instance by adding a spatial component to account for distance between points? The authors replied that estimations of ARS and state-space model locations (chosen based on resolution of ARGOS data) are in 4-hour time steps, and therefore we are not able to put as much credence on very small details within the tracks because they are extrapolated. There is a tendency to try to make inferences on the 2 behaviour states (transit and ARS) but we really don't know what the animals are actually doing. Fine scale data are useful to determine patch size and residence time, but maybe the MCPs are not as useful for interpretation as patch size or as feeding areas? It was suggested to not attempt to produce MCPs because of length of tracks and data resolution.

It was noted that based on the krill data, the centre of patches may not be that important (because the blue whales feed on periphery); therefore patches based on MCPs should be interpreted with caution.

There was some discussion regarding Figure 5 (number of individuals migrating versus not migrating). The authors stated that there is a need to clarify this figure considering that tagging continues throughout. The authors are trying to show when whales leave the Gulf, but are not sure how to best illustrate which animals are leaving versus staying in the Gulf. It was noted that these data are highly censored because we don't know when they entered the Gulf (i.e. all were tagged inside the Gulf), so it may not be a useful exercise to calculate this. What we really want to know is the residence time in the specific foraging area. The authors cannot use residency time to answer this; what we want to know is when most animals have left the Gulf, and want to know when they are in the Gulf to address potential impacts in the area that are time-dependent (e.g. seismic surveys). It was noted that this information is important but probably needs to be presented differently (e.g. compare to PAM estimates of residency time in the estuary). The committee agreed that this figure should either be removed or altered significantly to improve its clarity.

WORKING PAPER 3F: SPATIAL DISTRIBUTION OF KRILL IN THE GULF OF ST. LAWRENCE AND ON THE SCOTIAN SHELF: A CLIMATOLOGICAL APPROACH BASED ON HISTORICAL PLANKTON NET AND ACOUSTIC DATA

Authors: PLOURDE, S., MCQUINN, I.H., LESAGE, V., JOLY, P., BOURASSA, M.-N.

Rapporteur: Ashley Kling

Discussion: The committee asked the authors to provide an abstract in the document.

The committee requested clarification in Figure 8 regarding the accuracy of the dots on the map. For example, acoustic recorders appear right below some areas of high krill abundance - should blue whales be expected there? The authors replied that no, there may be a greater probability of finding krill there, but likely not every time. Dynamic conditions, and the many ways krill can be affected were emphasized.

The committee agreed that this paper would become a Technical Paper (and not a Research Document), since nothing from this paper is specifically going to be used to form the advice, but rather provides the background and support for Working Paper 3G.

WORKING PAPER 3G: MODELLING KRILL DISTRIBUTION IN THE NORTHWEST ATLANTIC USING STATISTICAL HABITAT MODELS

Authors: STÉPHANE PLOURDE, CAROLINE LEHOUX, IAN H. MCQUINN, VÉRONIQUE LESAGE

Rapporteur: James Pilkington

Discussion: The committee asked if the authors analysed the data at a smaller time scale (other than pooling 5 years). The authors replied that they wanted to use relative abundance, but this didn't work. Therefore, they used normalized data (because effort was not uniform) and pooled the years, treating as replicates.

Because one of the strengths of GAMs is they can deal with non-normal data, the authors were asked why they normalize the data. The authors replied that the published literature says that use of non-normalized data is not advisable and they had received comments advising against using non-normalized data.

It was asked whether the authors may be imposing a more rigid (flat surface, number of knots) relationship in models than is advisable. The authors replied that, for sea-surface temperature (SST) it is likely appropriate based on the established relationship between various species and temperature. A participant mentioned that they could impose GAMMA = 1.4, and compare between static versus dynamic models to support their choice of dynamic model. The authors were not focused on distribution, but on how processes (not just static variables) might affect distribution.

The committee asked that the authors rerun the model with less knots (imposing rigidity) and compare the difference in outcomes. If there is a significant difference, then the authors should rewrite results and send to the committee.

WORKING PAPER 3H: SPATIO-TEMPORAL EXPOSURE OF BLUE WHALE HABITATS TO SHIPPING NOISE IN ST. LAWRENCE SYSTEM

Authors: AULANIER, F., SIMARD, Y., ROY N., AND GERVAISE, C.

Rapporteur: James Pilkington

Discussion: Some participants were surprised to see few differences between winter and summer and asked if there was an effect of ice on sound propagation. The authors stated that ice is not a major effect, but it does have a minor effect (because most of the ships are in ice-free areas). High resolution ice data are not available, and it is probably not an important factor.

It was noted that some of the assumptions presented regarding ice development are incorrect. Ice develops in the west, then moves east as season progresses. The authors may want to rethink potential for impacts of ice in winter.

The committee requested clarification regarding how ship source levels were computed. The authors stated that they followed ANSI protocol as much as possible.

It was noted that audiograms for blue whales do not exist, so it is challenging to infer impacts to communication range. The authors assigned signal-to-noise ratio (SNR) of 0 as the threshold, but it is unknown if they are able to hear anything more sensitive. The authors discuss the

communication space in the paper, and also discuss communication effectiveness. Masking low-SNR of the signal may not just mask the signal, but also the message the signal was meant to carry, so the issue of masking is complex. They recognize that SNR of 0 is likely not sensitive enough (whales can possibly hear quieter sounds). The committee stated that using 0 dB as a minimum SNR may not be representative, so we have to be careful about how to interpret this when we don't know how it affects the whales.

It was suggested that in addition to presenting the best and worst case scenarios for communication space impacts, the authors should also present a median scenario.

WORKING PAPER 3I: INFORMATION RELEVANT TO THE IDENTIFICATION OF CRITICAL HABITAT OF BLUE WHALES IN THE NORTHWEST ATLANTIC

Authors: LESAGE, V., GOSSELIN, J.-F., LAWSON, J., MCQUINN, I., MOORS-MURPHY, H., MOSNIER, A., PLOURDE, S., RAMP, C., SEARS, R., SIMARD, Y.

Rapporteur: Jean-Francois Gosselin

Discussion: The discussion concentrated on the final integration map of the working paper that became Figure 17 in the Research Document. Discussions were related to the scientific evidence from the different research documents presented during the meeting to support the boundaries and the validity of areas important for blue whales as summarised in Figure 16 of the Research Document. Out of fourteen areas delimited and presented in the working paper, six remained after the review and discussions.

Lower estuary and northwest gulf of St Lawrence: An area important for blue whales was identified in the lower marine estuary and the northwestern Gulf of St. Lawrence. The area extends from Tadoussac at the upstream limit, and includes all the estuary from the south shore to the north shore down to the Manicouagan Banks and Matane. It then extends onto the coastal shelf and slope along the north shore to the Mingan Islands and along the south shore to the point of the Gaspe peninsula where it further extends offshore to include the north of the Shediac valley. The area is currently used for foraging, feeding and socializing for most part, with the exception of the Mingan Island area that has shown a decline in use from the 1980-1993 period to the 1994-2008 period. However, the area extends to the Mingan Islands based on observations and modelling krill occurrence and density which is estimated to be continuous along that coast. The initially proposed extent of the area offshore from the Gaspe Peninsula over the Shediac Valley was reduced to an area that showed overlap between the area covered by the movements of a few satellite-tracked blue whales, suggesting foraging (areas of restricted search) and an area of high density and occurrence of krill estimated from observations and modelling.

Mecatina Plateau and head of the Esquiman Channel: An area that covered the Mecatina Plateau and the head of the Esquiman Channel was identified as important for blue whales based on historical whaling data and the distribution, abundance and occurrence of krill. No recent blue whale sightings were presented for this area, but recent survey effort has been limited in the area in recent years.

South and southwest of Newfoundland: An area delimited by a line that extends from Cape St George to Cape St Mary's and that remains at least 30km off the southern shore of Newfoundland to include St George's Bay, Burgeo Bank and Placentia Bay was identified as important for blue whales. This was based on historical whaling data, predicted occurrence of krill from models, current sightings, and medium chances of occurrence of blue whales calculated from habitat modelling. An area initially proposed to extend all the way to the

continental shelf edge was eliminated, as most of the above justifications indicated that the coastal area was more important.

The continental shelf edge off Nova Scotia, Newfoundland and the Grand Banks: A single continuous long area was identified to cover the continental shelf edge off Nova Scotia, southern Newfoundland and the tail of Grand Banks, and from the Fundian Channel to around the tail of the Grand Banks to 45°N. The importance of this area for blue whale was supported from opportunistic and survey sightings, the movements of satellite tracked animals that revealed possible foraging (i.e. areas of restricted search), passive acoustic monitoring that record animals throughout the year and the models that predicted a medium probability (i.e. higher than 50% of occurrence) of euphausiids in spring and summer, and a high probability of occurrence of blue whales. The four areas described above were identified as important for blue whales to forage, feed and socialize.

The following two areas were identified as important migration corridors.

The Cabot Strait area and the Honguedo area: The Cabot Strait area extends on the south side from East Point (Pointe de l'est) on the Magdalen Islands to Cape St Lawrence in Cape Breton Island and along its coast to Northern Head near Glace Bay; the north side extends from Cape St George to Cape Anguille, near Codroy, and along southwest Newfoundland to Port aux Basques. Cabot Strait is an obligatory migratory passage to get in and out of the Gulf of St Lawrence. Passive acoustic monitoring suggests that blue whales are present in this area throughout the year, and ice entrapment data suggests that the area is important in spring as animals may be moving into the Gulf.

The Honguedo area extends on the south side from Grande-Vallée to Cap Gaspé along the Gaspe Peninsula coast, and from Pointe de l'Ouest to Pointe du Sud-Ouest on the north side along the Anticosti Island coast. The Honguedo area is an important migratory corridor to get in and out of the northwest Gulf and into the St Lawrence estuary.

The two zones were not connected because there are other activities going on in between and these areas really represent the obligatory or important migratory gateways where movement is restricted.

Areas discussed but not retained as important for blue whales: Several areas that were proposed for discussion as potential important areas for blue whales were rejected based on the lack of supporting scientific evidence. Krill occurrence suggested two areas on the eastern Scotian Shelf that were rejected due to the absence of blue whale sightings either from recent survey efforts or whaling data, and the absence of any evidence of foraging by the few blue whales tracked using satellite tags. The mouth of the Bay of Fundy could show possible occurrence of krill from the model, but the limited number of sightings of blue whales in the area given the extensive survey effort for right whales suggest that the area is not particularly important for blue whales. The south side of the Laurentian Channel and the east side of the Esquiman channel showed more than 50% probability of occurrence of krill, but no significant areas of krill were identified and the number of reported blue whale sightings in these areas is limited so the proposed area was rejected. Modelling suggested significant areas of krill occurrence along the northeast Newfoundland coast, but the absence of sightings (given a lot of opportunistic and whaling effort) suggest the area is not important for blue whales. The information on distribution in winter is very limited. Passive acoustic monitoring suggests animals may be in some areas all year round however, there are data from only two individuals who were tracked during the winter months. Data on historical whaling during the winter are also limited but suggest that distribution may be diffuse.

Attributes table: In the attributes table, it was suggested to include precision on the depth at which krill aggregations may be preferred by blue whales in the estuary and Gulf of St Lawrence, i.e. at less than 100m depth. It was suggested to include the species of krill that blue whales are foraging on in the gulf and on the Scotian Shelf (i.e. *Meganyctiphanes norvegica* and *Thysanoessa raschii*). Surface currents, bathymetry and krill swimming behaviour were added in the attribute table to identify the processes or features that contribute to the formation of krill aggregations. There was a need to refine the description of a suitable acoustic environment and make the link with the functions that it supports (i.e. socialising, navigation and the possible detection of prey).

Activity likely to destroy critical habitat: It was suggested that this exercise could be completed after the meeting given the information provided. Several participants offered to help ensure the table was complete.

Contaminants: Contaminants were included in the activities likely to destroy critical habitat because of the potential of reducing the availability and the quality of prey that may occur through indirect ecosystem level effects.

WORKING PAPER 4: ASSESSING THE RISK OF LETHAL SHIP STRIKES TO HUMPBACK (*MEGAPTERA NOVAEANGLIAE*) AND FIN (*BALAENOPTERA PHYSALUS*) WHALES OFF THE WEST COAST OF VANCOUVER ISLAND, CANADA

Authors: L.M. NICHOL, B.M. WRIGHT, J.K.B. FORD

Rapporteur: Marianne Marcoux

Discussion:

It was suggested to clarify the label of the scales on the maps.

It was noted that surveys were conducted in autumn and winter but that they are comparing those data with year-round shipping traffic. It was suggested to clarify this in the methods. In addition, it was noted that the project compares three years of whale data to one year of shipping traffic; this should also be discussed in the paper.

It was noted that there was a high risk of ship strikes in Juan de Fuca Strait, but there were no sightings of fin whales in the Strait, and it was explained that the model cannot output zero risk. The committee noted that this issue must be clarified in the paper.

The quality of data from the source for projection of shipping was questioned (San Juan Islanders for Safer Shipping). After discussion, it was agreed that this source was acceptable. It was also noted that the Port of Vancouver just released a new report on projected ship traffic that might be worth considering for future work.

It was suggested that the probability curve from Conn and Silber 2013 be used instead of the curve from Vanderlaan & Taggart 2007. It was noted that the more recent curve is based on world-wide data with confidence intervals.

It was suggested that ship size, width and draft could be incorporated in the modelling for future work. This suggestion should be mentioned in the limitations.

It was noted that the only term selected in the model was square-root (depth). It was suggested that the use of this term should be justified in the research document and that the impact of using a square root should be included in the document. It was also noted that since square-

root (depth) was the only variable selected, the model predicted fin whales in the Strait of Juan de Fuca even though there are no sightings of fin whales in the area.

It was suggested that future models combine a binomial model with the GAM to allow for zeros in the predictions.

It was asked if the model could be used to assess how many whales might die every year from ship strikes. The authors stated that it was not the purpose of this model and that the PBR (Potential Biological Removal) value was included in the paper just for context.

It was suggested that future work should consider species-specific vulnerability: diving pattern, and daily patterns should be noted in the limitations of the model.

It was noted that one limitation of the model was that the GAM was too simplistic (only one predicting variable included). This limitation should be discussed in the research document. In addition, additional suggestions were made to:

- Include the predicted power for the model in the document.
- Clarify that several models were attempted and that best model was the one with sqrt(depth). It is important to understand the results of the model because these densities might be used in the future.
- Clarify that future models should include more dynamic variables and more data about seasonal distribution.
- Rerun the model with depth instead of sqrt(depth).
- Try a Tweedie distribution.
- Use a 2D smoother with latitude-longitude

Some suggestions were made to improve the model for future work with respect to the characteristics of ships. It was suggested to use a range of ship speeds for predictions. It was also suggested to include new shipping routes if they were known. It was suggested to include seasonality in the shipping traffic and route. It was also noted that ship type should be explored.

It was agreed that the model is a good first step to understand the probability of ship strikes. It was suggested to clarify how the model could be used. Two different ways that the model could be used were also discussed:

1. to advise managers: what could be the impact of shipping on whale population? In this case, both the whale distribution and ship distribution would be used; and
2. to advise a single ship about where the whales are to avoid ship strike. In this case, only whale distribution is needed.

WORKING PAPER 5: ABUNDANCE AND DISTRIBUTION OF HARBOUR SEALS (*PHOCA VITULINA*) IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA

Authors: SHEENA P. MAJEWSKI AND GRAEME M. ELLIS

Rapporteur: Jack Lawson

Discussion: The Committee concurred with the authors' conclusions that the Harbour Seal population estimate values in this Working Paper are generally similar to previous estimates for most subareas, and that additional survey areas have been added outside the Strait of Georgia (SOG).

The Committee also concurred with the authors' conclusion that the number of seals at many sites appear to be varying over years, and with their assumption that this evidence indicates ongoing shifts in distribution. The authors proposed that a spatial analysis be conducted on Harbour Seal habitat use, and the Committee welcomed this suggestion.

After discussion of the information presented in Figure 3, several of the Committee members asked whether the apparent stability of the population may be a function of the choice of a general logistic model to fit the population estimate data over time; this model might not detect a decline in this population. The authors stated that they had investigated several other fitting models and all came to similar conclusions regarding population stability, although the annual population estimates may be confounded by re-distribution of Harbour Seals amongst surveyed haulout areas.

There was discussion by the group regarding how the correction factor (CF) for seals not hauled out at the time of the survey might over-estimate, or underestimate, the abundance of Harbour Seals in the SOG. To better present and understand the possible role that different CFs might contribute to differences in the population estimates, the Committee suggested that the authors present both the variable and fixed/average CF data and figures independently. Also, the Committee felt it would be useful to present Olesiuk's Figure that summarized the time depth recorder (TDR) studies showing the effects of extending the aerial survey period before and after the peak low tide mark. The authors stated that surveys were re-flown at several haulout locations but that there was no clear change in numbers of Harbour Seals counted close to low tide; there was considerable day-to-day variation in the number of seals hauled out. The Committee recalled that the TDR data showed that approximately 60% of Harbour Seals hauled out at low tide point, so perhaps extending the flying period may not have a detectable effect on the haulout counts. The authors were asked to give an indication of how often they flew outside of the usual survey period and provide an opinion in the Research Document as to how this would affect the estimate (i.e., how many times did they replicate survey flights at different times around low tide, and how many Harbour Seals were present during the survey replicates). If these replicate surveys were performed on small haulout groups there may not be a noticeable impact on the overall population estimates.

The Committee asked the authors how using the average CF in the Working Paper might affect the overall Harbour Seal SOG estimate. The authors responded that it would likely underestimate the uncertainty of the abundance estimates but the authors do not have access to the Harbour Seal time depth recorder data used to determine the variance associated with the CF. The authors stated that in the future they plan to update the CF with information from areas outside the survey areas (e.g. nearby Washington State).

The Committee asked the authors whether the apparent decline in log booms (due to reduced logging in B.C.), which are used as haulout sites by SOG Harbour Seals, has impacted haulout site counts. The authors plan to consider this issue further, although they noted that Olesiuk assumed that the log booms accounted for only 5% of the overall haulout habitat in SOG estuaries; if this is true, a reduction in the total number of logging booms might not exert a large influence on overall SOG Harbour Seal population estimates. The Committee encouraged the authors' plans to examine change in logging boom habitat area in the SOG.

The authors confirmed for the Committee that the difference between the corrected and uncorrected survey line estimates represents the number of Harbour Seals assumed to be at sea during the surveys. A participant noted that uncorrected at-sea population estimates are available, equal to approximately 13,000 Harbour Seals in these area groups, and felt that they would provide an interesting addition to the overall SOG abundance analysis.

The Committee asked that the authors correct the Table 2 caption to clarify the data presented in the table. In fact, The Committee found Table 2 more confusing than useful as a source of evidence of seal movements in and out of these survey areas (and Figure 4 sums to 100% so does not present total population changes).

Originally, the seven survey areas were designed to allow for an area that DFO could survey in a single day during a period when Harbour Seal population numbered only 3,000 animals. The Committee suggested that the authors discuss whether these are preferred foraging areas. The authors stated they will examine the locations of subareas to assess whether distributional changes might be an anti-predator response to Transient Killer Whales.

The Committee asked that the authors clarify the relevance of this work to the Transient Killer Whale critical habitat assessment, and discuss what human activities could disrupt this resource and its distribution as a "feature" of critical habitat for Transient Killer Whales. Several members of the Committee stated that changes in the Transient Killer Whale feeding behaviour may have effected Harbour Seal haulout behaviour and preferred locations over time, and that there is some evidence that seals might be hauling out more often and for longer durations. The authors agreed to add this discussion to the final Research Document.

The Committee also suggested that the authors discuss what other factors might be driving these apparent Harbour Seal distribution shifts amongst subareas, such as human land use (etc.). The Chair noted that the Terms of Reference requested that the document describe the distribution. The Committee concluded that Figure 4 provides a good example illustrating these changes in subarea distribution since the numbers of Harbour Seals hauled out change as seals re-distribute.

REFERENCES CITED

BEST, B. D., C.H. FOX, R. WILLIAMS, P.N. HALPIN AND P.C. PAQUET. 2015. Updated marine mammal distribution and abundance estimates in British Columbia. J Cetacean Res.. Manage 15: 9–26

Conn PB, Silber GK. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. Ecosphere 4: Article 43

Gregr, E.J. and A.W. Trites. 2001. Predictions of critical habitat for five whale species in the waters of coastal British Columbia. Can J Fish Aq Sci 58 7: 1265-1285

Vanderlaan ASM, Taggart CT. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Mar Mamm Sci 23: 144–156

WILLIAMS, R. AND L. THOMAS. 2007. Distribution and abundance of marine mammals in the coastal waters of British Columbia, Canada. J Cetacean Res. Manage 9:15–28

APPENDIX A: LIST OF PARTICIPANTS

DFO:

Veronique Lesage – QC Science
Nicole Bouchard - QC - EFM
Christie Whelan – NHQ CSAS
Garry Stenson – NL Science
Jack Lawson - NL Science
Sean Macconachie – PAC SARD
Jen MacDonald – NHQ - SARD
Joe Crocker– NHQ - SARD
Ann Mariscak - PAC CSAS
Lesley MacDougall- PAC CSAS
Lisa Spaven – PAC Science
Tola Coopper– PAC Science
John Ford– PAC Science
Linda Nichol– PAC Science
Sheena Majewski– PAC Science
Robin Abernethy– PAC Science
James Pilkington– PAC Science
Brianna Wright– PAC Science
Miriam O– PAC Science
Sheila Thornton – PAC SARD
Don Bowen – MAR Science
Hilary Moors-Murphy– MAR Science
Shelley Lang– MAR Science
Nell den Heyer– MAR Science
Marianne Marcoux – C&A Science
Jean-Francois Gosselin – QC Science
Ian McQuinn– QC Science
Stephane Plourde– QC Science
Arnaud Mosnier– QC Science
Yvan Simard– QC Science
Ashley Kling – NHQ Science
Katherine Gavrilchuk– QC Science

Non-DFO:

Christian Ramp (Mingan Island Cetacean Study)
Rob Williams (Oceans Initiative)
Lance Barrett-Lennard (Vancouver Aquarium)

APPENDIX B: TERMS OF REFERENCE

National Marine Mammal Peer Review Committee (NMMPRC): Part II

National Peer Review – National Capital Region

February 23-26, 2016
Vancouver, BC

Chairperson: Garry Stenson

TOPICS

1. **Habitat Requirements for Killer Whale (Northeast Pacific northern and southern resident populations), Fin Whale (Pacific), and Blue Whale (Atlantic)**

Context

When an aquatic species is listed on Schedule 1 of the *Species at Risk Act* (SARA) as Threatened, Endangered or Extirpated, Fisheries and Oceans Canada (DFO) is required to identify and protect habitat required for the survival and recovery of the species, which is linked to the population and distribution objectives established in a species' recovery strategy. The identification is based on the **best available information** at the time, which is typically provided in the form of scientific advice (peer-reviewed research documents and scientific advisory report).

In support of the requirements under SARA, DFO Science has been asked to undertake an assessment of important habitats for Killer Whale (Northeast Pacific northern and southern resident populations), Fin Whale (Pacific population), and Blue Whale (Atlantic population). The *Guidelines for the Identification of Critical Habitat for Aquatic Species at Risk* (DFO 2015) must be consulted (or followed to the extent possible) and alternate approaches, if any, justified. This advice will be considered (by the relevant recovery teams and Species at Risk Program at DFO) in the identification of critical habitat for applicable recovery strategies or action plans for these species.

Objectives

- To provide the best available information (including uncertainties and data gaps) to support the identification of important Killer Whale (Northeast Pacific northern and southern resident populations), Fin Whale (Pacific population), and Blue Whale (Atlantic population) habitats, such that the following elements are addressed.

Element 1: Describe the habitat properties that Killer Whale (Northeast Pacific northern and southern resident populations), Fin Whale (Pacific population), and Blue Whale (Atlantic population) need for successful completion of life-cycle processes necessary for survival and recovery. Describe the function(s), feature(s), and attribute(s) of the habitat, and to the extent possible, describe how the biological function(s) are supported by the specific habitat feature(s).

This information can be provided in a summary table.

If this advice refines or expands previously identified critical habitat, provide a clear indication of whether any change is proposed to the functions, features, attributes identified in the recovery strategy or action plan.

Element 2: To the extent possible, provide information on the spatial extent of the areas in the distribution of Killer Whale (Northeast Pacific northern and southern resident

populations), Fin Whale (Pacific population), and Blue Whale (Atlantic population) that are likely to have the habitat properties identified in Element 1.

Clear maps in the highest resolution available are required for this element. Effort should be made to quantify and geo-reference the amount of habitat of various types as thoroughly as possible. Advice on both the total amount and geographic location of the habitats is needed for the subsequent elements. Guidelines for identifying the quality and quantity of habitat available at present and that which is needed for a species to achieve recovery goals for abundance, range, and a certain number of populations are available in DFO (2007a).

Provide a clear statement as to whether the identified habitat is sufficient for the survival and recovery of the species, given the population and distribution objectives identified in the species' recovery strategy (Beauchamp et al. 2009, DFO 2011, Gregr et al. 2006). If current data is inadequate to determine whether identified habitat is sufficient, or if it is not sufficient, provide a clear statement explaining why the best available information is inadequate and identify the knowledge gaps that need to be addressed in order to provide advice necessary to support complete identification of critical habitat (e.g. schedule of studies, data required, modeling approaches that should be used).

Provide advice on the degree to which the supply of important habitat meets the demands of the species both at present and when the species has recovered.

Element 3: Identify the activities most likely to destroy the habitat properties identified in elements 1 and 2 and provide information on the extent and consequences of these activities.

The information from this element can subsequently be used to support the identification of activities that are likely to damage or destroy critical habitat.

The activities identified may be occurring within or outside the boundaries of the habitat identified in Element 2, but may still have an impact on the habitat identified in Element 2. The activities should be both likely to occur and likely to result in destruction of the function of that habitat.

Provide the threshold level (if available) at which the activity will render the habitat unable to serve its function when needed by the species. Provide an explanation as to how the activity may impact habitat function including a consideration of whether timing plays a role in the activity (i.e. mechanism through which the impact occurs, such as a pathway of effects).

If this advice refines or expands previously identified critical habitat, provide a clear indication of whether any change is advised to the activities likely to result in the destruction of critical habitat identified in the recovery strategy or action plan. The identified activities should be consistent with the threats identified in the species' recovery strategy. If this is not the case, this advice should provide an explanation for any deviation.

2. Population status of the Harbour Seal (*Phoca vitulina*) in Transient Killer Whale foraging habitat in the Strait of Georgia, British Columbia

Context

In coastal waters of British Columbia, Harbour Seals (*Phoca vitulina*) are the most frequently documented prey species of Transient Killer Whales. Until the early 1970s, there were active programs to cull both Harbour Seals and Steller Sea Lions in British Columbia. By the time these programs were concluded, Harbour Seal abundance in British Columbia had been reduced to ~10,000 individuals. By the 1990's, their numbers rebounded tenfold to their pre-cull abundance (Olesiuk 1999), and 2008 estimates indicate that the population had stabilized with ~105,000 individuals inhabiting Canadian Pacific waters (DFO 2010).

As a primary prey species for the threatened Transient Killer Whale population, the availability of the Harbour Seal plays an important role in recovery of the species. The Recovery Strategy for Transient Killer Whales (DFO, 2007b) identifies the need to determine the quantity, quality and distribution of Transient Killer Whale prey necessary to sustain or increase the current population level. Ongoing monitoring of the Harbour Seal will assist in meeting this objective.

In 2012 (DFO, 2013a), DFO Science Advice on the habitat necessary for the survival or recovery of the Transient Killer Whale was developed and is currently being considered for identification as critical habitat for Transient Killer Whales.

DFO Species at Risk Program has requested Science advice on the current population status of Harbour Seals to assist in further refining the features, functions and attributes of the habitat necessary for survival or recovery of the Transient Killer Whale. Based on surveys conducted since the last assessment in 2008, an updated abundance assessment for Harbour Seals in British Columbia has been developed. This information will be used to meet recovery strategy objectives involving prey availability, as identified in the Recovery Strategy for Transient Killer Whales (DFO, 2007b).

In addition to supporting recovery of the Transient Killer Whale population, information on Harbour Seal abundance and distribution is routinely required for responding to issues such as environmental assessments, habitat referrals, siting of finfish and shellfish aquaculture facilities, evaluating impacts on local fishery resources, and in considering requests for culling and the issuance of nuisance seal licenses.

Objectives

Update the state of knowledge regarding the population status and distribution of the Harbour Seal (*Phoca vitulina*) in the Strait of Georgia.

3. Assessment of the risk of ship strike to large cetaceans in the Pacific Region

Context

Large whale species occupy shelf-break regions that frequently coincide with shipping lanes, where large vessels such as cruise ships, cargo and container ships and tankers converge as they approach coastal ports. Southwestern Vancouver Island includes a large shelf-break region that coincides with the shipping traffic approaches to Juan de Fuca Strait. This shipping corridor connects to numerous ports in the Vancouver Lower Mainland area, including Port Metro Vancouver, one of the largest ports on the west coast of North America, as well as to ports in Puget Sound, WA. Vessel collisions with whales are an anthropogenic source of mortality for several species, including Blue, Fin, and Humpback Whales world-wide (Laist et al. 2001, Jensen and Silber 2004). Ship strikes resulting in mortalities to these species have been reported from British Columbia, Washington and California (Gregr et al. 2006, Douglas et al. 2008, Ford et al. 2009). Although the number of reported ship strikes is low, such records are known to underestimate the true frequency of occurrence: in many cases, ship strikes are undetected by ship operators, and whale carcasses sink before drifting into coastal waters where they might be reported incidentally by coastal mariners. As a result, statistics based on direct estimates of wounds, or recovery or sightings of whale carcasses, under-represent the true frequency of ship strikes (Laist et al. 2001; Douglas et al. 2008). Modelling whale distributions and ship traffic distribution offers an alternate approach to assess the risk of an encounter and the likelihood of the encounter having a lethal outcome.

The SARA Recovery Strategies for Blue, Fin and Sei Whales (Gregr, 2006), Humpback Whales (DFO, 2013) and North Pacific Right Whales (DFO, 2012) identify ship strikes as a threat to the recovery of these species. An assessment of ship strike risk for Humpback and Fin Whales for

the west coast of Vancouver Island, modelling whale distributions and ship traffic distributions *has been conducted.*

The DFO Species at Risk Program has requested Science advice regarding methods to assess the threat to SARA-listed large whale species from ship strikes, and to provide estimates of the risk of mortality to large baleen whales off the west coast of Vancouver Island. Results and advice arising from this assessment will assist both DFO's SARA program and Fisheries Protection Program when considering potential impacts to species and habitats arising from projected increases in shipping traffic, and will provide information for consideration by DFO's Oceans Program in the development and management of a protected areas network.

Objectives

- Review the methodology to assess ship strike incidence and mortality to large whales.
- Assess the current and future risk of ship strike incidence and mortality to SARA-listed species such as Blue Whales, Fin Whales and Humpback Whales off the west coast of Vancouver Island.
- Provide recommendations for any modifications to the methodologies or further work required to adapt the model / methodology for use in other areas or other regions, and for other marine mammal species.

Expected Publications

- CSAS Science Advisory Reports
- CSAS Proceedings
- CSAS Research Documents

Participants

- Fisheries and Oceans Canada (Ecosystems and Oceans Science, and Ecosystems and Fisheries Management, Species at Risk sectors)
- NOAA
- Cascadia Research
- Vancouver Aquarium
- Oceans Initiative
- Mingan Island Cetacean Study
- Academia
- Other invited experts

References

Beauchamp, J., Bouchard, H., de Margerie, P., Otis, N., Savaria, J.-Y., 2009. Recovery Strategy for the blue whale (*Balaenoptera musculus*), Northwest Atlantic population, in Canada [FINAL]. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. 62 pp.

DFO. 2007a. Documenting Habitat Use of Species At Risk and Quantifying Habitat Quality. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/038.

DFO. 2007b. Recovery Strategy for the Transient Killer Whale (*Orcinus orca*) in Canada. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Vancouver, vi + 46 pp.

DFO. 2010. Population Assessment Pacific Harbour Seal (*Phoca vitulina richardsi*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/011.

DFO. 2011. Recovery Strategy for the Northern and Southern Resident Killer Whales (*Orcinus orca*) in Canada. *Species at Risk Act* Recovery Strategy Series, Fisheries & Oceans Canada, Ottawa, ix + 80 pp.

DFO. 2012. Recovery Strategy for the North Pacific Right Whale (*Eubalaena japonica*) in Pacific Canadian Waters. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. vii + 51 pp.

DFO. 2013a. Information in Support of the Identification of Critical Habitat for Transient Killer Whales (*Orcinus orca*) off the West Coast of Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/025. 14pp.

DFO. 2013b. Recovery Strategy for the North Pacific Humpback Whale (*Megaptera novaeangliae*) in Canada. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. x + 67 pp.

DFO 2015. *Guidelines for the Identification of Critical Habitat for Aquatic Species at Risk*.

Douglas, A.B., J. Calambokidis, S. Raverty, S.J. Jeffries, D.M. Lambourn and S.A. Norman. 2008. Incidence of ship strikes of large whales in Washington State. Journal of the Marine Biological Association of the United Kingdom, 2008, 88(6), 1121–1132 p.

Ford J.K.B., A.L. Rambeau, R.M. Abernethy, M.D. Boogaards, L.M. Nichol and L.D. Spaven. 2009. An Assessment of the Potential for Recovery of Humpback Whales off the Pacific Coast of Canada. DFO Can. Sci. Advis. Sec. Res. Doc.2009/015. iv + 33 p.

Gregr, E.J., J. Calambokidis, L. Convey, J.K.B. Ford, R.I. Perry, L. Spaven, M. Zacharias. 2006. Recovery Strategy for Blue, Fin, and Sei Whales (*Balaenoptera musculus, B. physalus*, and *B. borealis*) in Pacific Canadian Waters. *In* Species at Risk Act Recovery Strategy Series. Vancouver: Fisheries and Oceans Canada. vii + 53 pp.

Jensen, A.S. and G.K. Silber. 2003. Large Whale Ship Strike Database. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-OPR-, 37 pp.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, M. Podesta. 2001.Collisions between ships and whales. Marine Mammal Science 17(1):35-75.

Olesiuk, P.F. 1999. An assessment of the status of harbour seals (*Phoca vitulina*) in British Columbia. CSAS Res Doc 99/33.